SCIENCE

FRIDAY, SEPTEMBER 9, 1887.

IN A COMMUNICATION made last year to the French Academy of Medicine (*Science*, viii. p. 29), Dr. Worms gave the results of his investigations concerning color-blindness among the *personnel* of the Northern Railway. The figures which he gave showed so small a percentage of color-blind employees as to warrant the conclusion that there is not much danger to be feared for railroad travellers from these defects. More recently Dr. Worms has informed Dr. Jeffries of Boston that this percentage was found among those employed after all had been examined on entering the service previously, — an explanation which gives an entirely different phase to the matter. The statistics given by Dr. Worms, and to which we have already referred, have been repeatedly quoted as an argument by those who do not admit the prevalence of color-blindness among railroad employees, and who therefore deem color-testing unnecessary. This use of the figures of Dr. Worms, which was justifiable in view of the form in which they were originally given, should now be abandoned in view of the later information received from him. This subject of color-blindness among railroad employees is attracting the attention of thoughtful men in all parts of the world. In our own country, Massachusetts has a statute in relation to the matter. This directs that no person shall be employed upon a railroad in any capacity which requires him to distinguish form or color signals unless he has been examined as to his sight by some competent person employed and paid by the railroad company, and has received a certificate. The phrase 'competent person' is a very elastic one, and it is feared that the examiner is not in all cases competent to make the tests. The Alabama legislature has enacted a law which is pronounced to be the best yet devised to overcome this evil. It provides for examinations conducted by experts, not according to rules of their own, but guided by standards both of visual power and of color-sense which are fixed by law. The railroad employees, under this law, are divided into two groups, — one containing engineers, firemen, and brakemen, in whom a high visual power and color-sense are demanded, and the other containing gatemen, conductors, and others, to whom an inferior standard is applied. Connecticut at one time had a law upon this subject, but, after one year's trial, so many employees were found deficient that in obedience to the demand of politicians it was repealed. In one instance a board of experts found twenty-four railroad employees to be color-blind. Their report of these facts created such an outcry among their friends that another test was demanded, with flags and lanterns and not with colored worsted as in the former test. This resulted in proving that of the twenty-four, twenty-one were wholly color-blind, and three color-blind in part. Dr. Worms has recommended that exercises on the colors should be carried out in the schools to reduce the percentage of the color-blind. In commenting on this recommendation, Dr. Jeffries says that no exercise with colors can change the congenital color-blind, who are four per cent of males everywhere. We hope to see this subject agitated until the provisions which are now in force in Alabama shall apply throughout the United States. It matters little to a traveller that his life is secure in one State by reason of stringent laws against color-blindness in railroad employees, if as soon as he crosses the boundary line and passes into another State, in which no such law exists, his life may be sacrificed by a color-blind engineer who, mistaking the red light of danger for the white light of safety, runs his train through an open drawbridge into the river below.

CO-OPERATION ON THE CONTINENT OF EUROPE.

II. GERMANY.

THE reply from Germany to Lord Rosebery's circular letter (see *Science*, No. 220, p. 395) is more systematic than that from France. At the very outset the writer says that among the working-classes of Germany co-operation has met with little favor: the well-to-do classes, on the other hand, have applied its principles with considerable success in many directions. This reluctance on the part of the working-people to co-operate is ascribed in a large measure to the fact that as a class they are incapable of appreciating the value of making provision for the future. They are not yet educated up to the point of making industrial co-operation a real factor in the improvement of their condition. The tendency toward State socialism in Germany is also an obstacle to co-operative development. Statistics as to co-operation are not easily obtained in Germany. Both the government and private societies are very reticent when asked for information on commercial or industrial questions. The most observant notice of co-operative movements, so far as they concern the artisan and laboring-classes, is probably taken by the Central Association for the Welfare of the Laboring-Classes, and its organ, the *Arbeiterfreund;* while very valuable statistics are to be found in the yearly report of the Central Union of German Co-operative Societies, on all which the report from Germany is based.

Associations belonging to this Central Union of German Co-operative Societies are entitled 'Registered Associations,' and are established under the Prussian law of March 27, 1867, and the German law of July 9, 1868. These laws grant special privileges to co-operative societies; that is to say, associations not restricting themselves to any fixed number of the members composing them, and got up with a view of facilitating the obtaining of credit, the earning of a livelihood, or prosecution of husbandry by their members by means of joint management of their business. A great number of associations have united themselves under the leadership of a counsellor in the Central Union.

Such enterprises are in Germany indissolubly connected with the name of their great founder, Schulze-Delitzsch. The movement, which he started and organized with extraordinary genius, is entirely based on the principle of 'self-help.' "If a man cannot save a few pence by denying himself a couple of glasses of beer a week," said Schulze, "I can do nothing for him." The history of Schulze's attempts are briefly as follows: In 1849 he founded at Delitzsch, in Saxony, a 'sickness and death' fund, which, for a small monthly subscription, afforded help and medicine to the poorer artisans and laborers in case of illness, continuous pecuniary support in cases of incapacitation for work, and contribution towards funeral expenses in cases of death. In 1850 Schulze started a loan society, and, in re-organizing the same in 1851, he introduced the principle of unlimited liability, and completed his system, as far as essentials were concerned, by forming capital for individual members by the introduction of inalienable shares. The example thus set was quickly followed, and many mutual help societies sprang up in various parts of Germany.

The principle of unlimited liability, on which Schulze most strongly insisted as the keystone of his system, was also adopted by Raiffeisen, who founded similar societies, chiefly in agricultural districts. The double effect seems to have been to raise the credit of co-operative societies, and to confine them to persons of small means, persons of larger fortune being shy of risking their whole property.

As mentioned above, the societies on the Schulze-Delitzsch plan have been regularly organized into an association, the principal objects of which were briefly described by him in the report of 1874 as being the following: "The General Union of the German Industrial and Economical Co-operative Societies, founded on the principle of self-help, the affairs of which are at present managed

by me as a salaried agent, sends delegates of the associations belonging to it to an annual general assembly, which controls the affairs of the union as supreme authority, without interfering with the independence or with the special affairs of the individual societies. As connecting links between the central authority and individual associations, subordinate unions, which embrace the societies of various German countries or provinces, or of special branches, have been formed, whose task it is to attend to their special interest, and to communicate between them and the central authority. They prepare for the general assembly in special assemblies of their own, and enforce the resolutions of the former in their districts, while the presidents chosen by them form a committee which assists the agent in carrying on the business of the union in the interval between the general assemblies. Thus, without interfering with the free action of the individual societies, a central point is created for the exchange of experiences, for the sifting and criticising of the ever-accumulating material, for advice and help for members in any kind of embarrassment, and finally for common defence against threatening danger. Add to these advantages the most valuable business relations between the several societies in the execution of commissions, and especially in mutual assistance with capital." The resolutions of the general assembly have only the force of advice, and their acceptance is enforced only by the weight of their own reasons, and not by pressure of any kind.

The number of societies in this association increased from 171 in 1859, to 771 in 1864, and was 3,822 in 1885. At the last-named date they were distributed thus: loan and credit societies, 1,965; co-operative societies in various branches of trade, 1,146; co-operative store societies, 678: building societies, 33. At the end of 1884 the membership was 1,500,000. Of their own capital, in shares and reserve funds, they possessed 300,000,000 marks; and of borrowed capital, 500,000,000 marks.

It may be mentioned that the co-operative movement in Germany is unfortunately at present associated with the Radical political opinions. Even Schulze, though at first he kept the movement free from political color, was carried along by the tide in his later years. The consequence has been that co-operative enterprise on the self-help principle is looked upon rather with suspicion by the ruling authorities.

Co-operative store associations exist in considerable numbers in Germany, and are in the main very successful. They bear the name of *Consumvereine*. Many of the earlier associations confined themselves to making contracts with dealers, provided that the latter granted a discount to the association on all goods sold, which discount was, after deduction of expenses, divided among the members.

Those formed since 1863 have followed more and more the principle of similar English associations. They give no credit, sell at the market price, and, after providing suitable interest for the business shares of the members, divide the net profits in proportion to the goods bought, which proportion is marked by dividend counters; but there are some very well conducted societies which sell at the lowest price possible, and divide the profits equally, or in proportion to the business shares of the members. As in England, the more developed societies are gradually undertaking the production of their own goods. The South German associations have taken a step towards the establishment of a common wholesale business by forming a joint stock company for the purchase of goods at Mannheim: in North Germany this was in 1878 still regarded as premature. Nearly all the important co-operative store associations have registered themselves under the Co-operative Societies' Law.

The proper principles on which such associations should be conducted are laid down by Schulze-Delitzsch as follows: 1. Those who buy from the society should themselves be members of it (sale to non-members is, however, allowed as being likely to induce the latter to join); 2. Business shares should be gradually acquired by the members up to a normal sum by the payment of a small subscription, or by accumulation of their dividends; 3. A common reserve fund is formed by keeping back a certain number of shares, and by a small entrance fee for members; 4. Capital is borrowed on the common security of members, or (though this should be avoided) goods are bought on their common credit; 5. Sales are for ready money, the profits being divided between the reserve fund and the members' dividends; 6. The manager and officials are paid according to the work they do; 7. The number of members is unlimited, entry into and withdrawal from the society being equally free.

These rules, being stamped with the great authority of Schulze, represent the general principles on which the vast majority of co-operative associations work, and are recommended to all by the Central Union.

The number of these co-operative stores twenty-five years ago was 41; in 1885 it was 678. Their average sales in 1884 were 190,025 marks. Their average holdings in business shares are 24 marks 6 pfennigs per member, and in reserve funds 14 marks 3 pfennigs per member. One hundred and sixty-three of the societies showed, in 1884, a dividend on capital and purchases of 2,412,366 marks, or 85 per cent.

For the failures in 1884 numerous reasons are given. One society failed in consequence of their "unfortunate choice of a storekeeper;" another in consequence of quarrels among the members; a third society were obliged three times to change their storekeeper, and eventually came to an end in consequence of the impossibility of finding a suitable person; a fourth came to grief in consequence of the desire of the members to divide the reserve fund. On this latter rock many societies have split. As soon as the society finds itself possessed of any considerable sum of money, individual confidence seems to give way, and greed of the immediate possession of their own share prompts the members to dissolve the association.

Co-operative workshops are not numerous in Germany, and the general opinion is unfavorable to them.

The favorable years, from 1870 to 1873, seemed to bid well for the establishment of a system by which the workmen should be made participators in the profits of their industry; and the governments of Germany took pains not only to try the system in their own works, but to obtain information as to its working elsewhere. The initiative was taken by Bavaria; and from an inquiry made in 1874 from fifty Bavarian firms, of whom about thirty sent replies, it appeared that in most cases such participation was confined to premiums, gifts, and a percentage to overseers and foremen. These cases were chiefly the result of individual liberality on the part of employers of labor, and, as they ceased in the time of industrial depression which succeeded, they are without scientific value.

The 'Report on Arrangements for the Benefit of Workmen in the Larger Industrial Establishments of Prussia,' published in 1876 by the Prussian Government, states that at that time there were 439 cases of establishments in which the workmen shared in the profits, and 61 where they shared in the capital. A closer analysis of these figures, however, shows that in most cases such participation was confined to the foremen and overseers, and that in only 16 cases did all the workmen have a share at once in the undertaking, and in 18 others after a certain lapse of time.

Schulze-Delitzsch always declared that productive associations, i.e., "associations of a number of small masters or of wage-laborers for the purpose of industry on a large scale for common account and at common risk," was the highest form of association, and the keystone of his whole system. Such associations, he pointed out, are most easily established the less capital they require, and the more readily the goods produced are sold. They are most difficult to establish in branches of industry which, owing to minute division of labor, require the co-operation of workmen of different trades, or which entail expensive machinery.

Hitherto the general history of productive associations in Germany seems to have been pretty nearly the following: a not very large number of workmen join together to establish a common workshop and sell their products for common account. The original intention of admitting new working members is frustrated by the fact, that, whereas an individual capitalist can increase or diminish the number of his hands according to the requirements of the market, every unfavorable conjuncture has the effect, in a co-operative association, of leaving some of the members not fully occupied. When better times come, the admission of new members is looked on with disfavor, because it only renders the position of the others worse if times of depression return. There is, further,

the difficulty that the advantages shared by the new members are the result of sacrifices on the part of the old, for which the latter are not indemnified. It consequently results that the associations refuse to admit new members, and in good times employ regular workmen hired for wages and liable to dismissal, and thus in the moment of success such associations lose the essential characteristics of co-operative societies.

To meet these difficulties Schulze recommends: —

1. The admission not only of members of the trade, but, as sleeping partners, of persons who, without taking any share in the industry of the association, are yet willing to venture a deposit of capital; and of workmen who enter the association at once, but, as they cannot be employed at once, remain for the time being as wage-laborers under other employers.

2. The participation of new members in the profits only after a certain lapse of time.

3. The application of borrowed capital, and not of the society's shares, to the acquirement of such real property as is required; such borrowed capital not being reclaimable before a certain date, but receiving interest.

4. Withdrawal from the association to be subject to as long notice as possible.

As to division of the profits, most German associations agree with Schulze, that, after the reserve fund has been duly considered, five per cent interest should be added to each business share; that then half the surplus should go to swell the shares as super-dividends, the other half being divided as bonus among all the workmen and officials according to the amount of salary they have received during the year.

It is very difficult to obtain accurate information respecting co-operative undertakings for productive purposes, as, from reasons of trade, such associations are very reticent with regard to their working.

In the report of the German Co-operative Union for 1884, 145 productive associations are mentioned under the following divisions: —

21	Cabinet and instrument makers' associations.
17	Spinners and weavers' "
13	Millers and bakers' "
11	Booksellers and printers' "
10	Tailors' "
7	Butchers and slaughterers' "
7	Brewers' "
6	Cigar-manufacturers' "
6	Carpenters, builders, and stonecutters' "
5	Metal-workers' "
5	Spirit and brandy distillers' "
5	Shoemakers' "
5	Clockmakers' "
24	Miscellaneous "

The same report gives statistics of 10 associations which made a net profit of 5.5 per cent, allowing of a dividend of 13.6 per cent, as against 16.0 per cent in 1883, and 13.5 per cent in 1882. Whether this dividend is paid to the members in money down or not does not appear. Of the working capital of these societies, 36.4 per cent was their own.

Herr Borchet is the only authority who believes that the workmen's participation in the profits has prevented strikes.

The most conspicuous examples of co-operation in production are the Berlin Brass-Work Company, the Windhoff Foundry at Lingen, Möller's engine-works at Kupferhammer, Keilpflug's cigar-factory in Berlin, and the cotton-mills at Hasel.

Of all co-operative enterprises in Germany, the people's banks are the most developed and the most successful, and they appear to have in a great degree overcome the indebtedness and misery which were so often the lot of the working-classes a quarter of a century ago, in consequence of the usurious interest that they were compelled to pay, especially in agricultural districts, on even the smallest loan.

The main principles on which these banks are founded are again those of Schulze-Delitzsch. They are: —

1. The loan-seekers are themselves the directors of the institution established for the satisfaction of their needs, and share the risk and the profit.

2. The transactions of the association are based throughout on business principles: the fund of the association pays to the creditors, and the loan-takers pay to the fund of the association bank, interest and commission, according to the rates in the money-market. The managers, especially those who have charge of the funds, receive remuneration according to their services.

3. By full payment once for all, or by small continuous contributions on the part of the members, shares in the capital of the association are formed, according to the amount of which the profit is divided, and placed to their credit till the full normal sum is reached, by which means an ever-growing capital of its own is acquired for the business of the association.

4. By the entrance fees of members and by reservation of shares, a common reserve fund is accumulated.

5. Sums further necessary for the complete carrying-on of the business are borrowed on the common credit and security of all the members.

6. The number of members is unlimited. Entrance is open to all who satisfy the requirements of the statutes, and it is free to any one to cease to be a member after giving due notice.

Not only artisans and manufacturers, but also others, especially agriculturists, merchants, and dependent workmen, avail themselves of these banks, and they have maintained and strengthened themselves in the confidence of the public through all crises.

The Giro-Union ('Circulation Union') of German associations deserves special notice. An account is opened at the Associations' Bank in Berlin in favor of each people's bank belonging to the Union. Each bank keeps a deposit of at least 300 marks there, which can be increased by deposits in specie, by bills on Berlin or any Prussian bank, or places where there are other loan associations, or by the transferrence of the deposit of a third party from his account to their own: it can, on the other hand, dispose of its deposit by transferrence to another account, kept by the bank, or by checks, bills payable at sight, or ordered consignment in specie. Though Schulze regarded this institution as extremely important, only a minority of the people's banks belonging to the general union belong to it also.

The number of people's banks belonging to the general union was 1,961 on Jan. 1, 1885.

Co-operative societies for educational purposes would appear not to exist in Germany, where educational facilities in every branch of learning are already amply provided for, and within the reach of the poor; but co-operative associations of various kinds often provide educational, social, and recreative facilities for their members.

Societies for building dwellings for the poorer classes have met with but little success in Germany. They appear to have succeeded best in Alsace; and one at Flensburg, in Jutland, founded in 1878, possesses, according to the report of 1884–85, 19 houses, with a value of 100,000 marks, and 800 members, one of whom has the sum of 87,000 marks to his credit in the society's books.

The formerly wide-spread system by which pasture-land, forest, fisheries, etc., were held in common, has almost entirely ceased to exist in Germany, in consequence of recent legislation. On the other hand, a movement has taken place, chiefly under the same auspices as the co-operative movement on the Schulze-Delitzsch principle, by which combination now plays a very important part in German agriculture.

Dairy co-operative associations have been started in all directions. There are further associations for the purchase and use of agricultural machines, the members paying a certain sum for the use of the common property, and associations for cattle-breeding, sheep-farming, hops, vegetable, and vine-insurance, and kindred objects.

THE STONE AGES IN TUNIS.

AN interesting report on the relics of prehistoric man in the regency of Tunis appeared in the May number of the well-known scientific periodical, the *Matériaux pour l'Histoire Primitive et Naturelle de l'Homme*. The author, Dr. R. Collignon, deputed by the Anthropological Society of Paris for this purpose, spent three years in traversing the country in every direction, and in making the observations and collections which are described in this report. Only the principal results can here be noticed; but these, it will be seen, are of great scientific value.

The most important observations were made in the district about

Gafsa, a considerable town in the southern part of the regency, preserving the site and the name of the Roman Capsa. The author describes three remarkable hills, which rise to a moderate elevation in the neighborhood of that town. These hills, having been made posts of observation of the occupying army, are now known as Posts I., II., and III. Post I. is an eminence rising on one side, by a gradual slope, to a height of sixty metres (about two hundred feet) above the level of the town, and descending on the other side in a steep, cliff-like face, of forty-two metres, to an upland plain. This precipitous face offered to the investigator the advantages of a cutting, showing the composition of the hill from base to summit. It proved to be, in the greater part, a limestone conglomerate, in which are embedded small particles of quartz, with rolled flint-stones of various sizes, and fragments of brown silex. Geologically, the hill belongs to the earliest period of the quaternary or pleistocene epoch. The lower half is of stone sufficiently compact to be quarried for building-stone. Above this is a layer, about eighty feet thick, of somewhat looser and more friable conglomerate, with larger embedded stones. And this, again, is surmounted by a stratum of yellow travertine, about six metres (twenty feet) thick, containing no flints.

The remarkable fact is, that throughout the conglomerate were discovered relics of human handiwork, in the shape of wrought flints embedded in the rock. Still more remarkable is the fact that in the lower and harder stratum these relics were all of one sort, while in the upper and looser layer that sort had disappeared, and other kinds had taken its place. In the lower stratum he found specimens of that rude tool — the rudest of all tools — which is described sometimes as the 'drift-implement,' sometimes as the 'axe of St. Acheul,' and by Prof. G. de Mortillet, in his noted work 'La Préhistorique,' as the 'fist' (*coup de poing*), — a stone clipped into an ovoid or almond-like shape, and intended evidently to be grasped at the smaller end and used in pounding or hacking. With these were some of the coarse flakes, or clipped fragments, which usually accompany them. These stone fists and flakes were all in the typical forms which distinguish the work of the earliest quaternary race, — variously known as the 'River-drift,' or 'Canstadt,' or 'Chellean' race, — and were the only traces of human industry found in that stratum.

In the looser stratum above, not one of the ovoid implements was found, though a single specimen was extracted just on the line of division between the two layers. All the worked flints in the upper layer belonged to what M. de Mortillet styles the 'Mousterian' type, but were mostly of a heavy, coarse, and worn appearance. They were of various shapes, — triangular points, thick blades, rude scrapers, and the like. Dr. Collignon is of opinion that the implements in the upper conglomerate stratum were a development of those in the lower; but the facts, as described by him, do not seem decisively to bear out this opinion. Finally, in the highest stratum of all, the travertine, as has been said, no flints of any kind were found. The hill known as Post III. resembles that of Post I., except that it is lower, and that the layer of travertine is wanting.

The necessary conclusions from these facts, as set forth by the author, are, that in the earlier part of the quaternary era this region was inhabited by the race or races of men who formed these implements. During a period of great but unknown length the land gradually sank, and was finally covered by the sea. When it again rose above the surface, the currents swept away nearly all the formation which had accumulated during this subsidence, leaving only a few hills, such as have been described, to indicate the original level.

After this denudation, a new but briefer subsidence took place, giving rise to a new formation, and followed by a new elevation. These facts are shown by the evidences displayed in and around another hill, known as Post II. This is one of the 'foot-hills' of a small mountain-chain which sinks gradually into the plain at a little distance north of Gafsa. Around these hills and on their declivities are scattered many small mounds of clayey loam. These mounds rest on a layer containing many coarse Mousterian implements, exactly similar to those in the upper conglomerate of Post I. Above this layer is a stratum of argillaceous earth, between three and four metres thick, containing no flints. Then follows a thin layer or film of earth, about four inches thick, full of flint implements of every description. This layer clearly indicates what was for a considerable period the inhabited surface. Above this layer are a few feet of earth; but the same implements are scattered profusely over the present surface, and are found below it where the soil is furrowed by the rains. They belong to every one of M. de Mortillet's 'ages,' subsequent to the Chellean and the earlier Mousterian; viz., the upper (or later) Mousterian, the Solutrean, the Magdalenian, and the Neolithic. So far as prehistoric Tunis is concerned, Dr. Collignon is satisfied that no distinction in point of time can be made among these different industries. It is clear, also, that they have continued in existence to a very recent period, since the soil which covers some of the Roman constructions holds flint implements of the same description.

A very curious fact, ascertained by Dr. Collignon, is that all these stone implements, of every age, are restricted to a comparatively narrow area in the south and west of Tunis. While they abound in that district, they are almost entirely absent from the northern and eastern portions of the country. Dr. Collignon does not attempt to explain this phenomenon. It may possibly be due to an early condition similar to that which exists at present in parts of our own continent, where two hostile races, like the Eskimo and the Athabascan Indians, are separated by a wide space of unoccupied land.

It should be mentioned that in the middle of the Tunisian territory there is a limited area, quite distinct from that in which the stone implements occur, where megalithic monuments — dolmens and covered passages — abound. In one locality no less than four hundred dolmens were counted. These monuments Dr. Collignon believes to have been the comparatively late constructions of an intrusive tribe; and he is further of opinion that the descendants of this tribe and of the stone-implement makers still live in their respective districts, and are distinguishable by their very different physical traits. In the district of the dolmens the people are of rather low stature (1.63 metres, or about 5 feet 4 inches, — an average which must be understood as including both sexes), with long heads (index 74), and a visage short, broad, and irregular, closely resembling in outline that indicated by the Cro-Magnon crania. On the other hand, the people of the south of Tunis are comparatively tall (1.69 metres, about 5 feet 6 1-2 inches), very dolichocephalic (index 73), with retreating forehead and chin, and projecting glabella and brows; the nose turned up, and the lips thick, but with no prognathism. They are neither negroid, Berber, nor Arab. In his view, they represent the earliest ethnic stratum of the existing population, and preserve the blood and the type of the people who dwelt in this region during the stone ages.

The positive conclusions which we seem authorized to draw from Dr. Collignon's report may be stated in a few words. They are, first, that the human race is of an immense antiquity, dating back to the beginning of the quaternary age; and, second, that the first race of men, judged from the relics of their industry, were of a very low grade of intelligence, little surpassing that of the most sagacious brutes; but how far this apparent defect of intellect was real, and how far it may have been due to the circumstance, that, as M. de Mortillet has suggested, the faculty of speech was yet undeveloped, is uncertain. Finally, it is plain that the period of this earliest stone age was of a vast duration, which can only be expressed in geological terms. The same may be said of the early Mousterian era, which perh aps formed part of the first age. As for the various so-called 'stone ages' which followed, it seems impossible to make any real distinction of periods among them. They all apparently form one modern epoch, not of very great duration, and not yet closed.

CHILLED ARMOR FOR LAND-DEFENCES.

THE Gruson Works of Buckau-Magdeburg have recently published a book of some size, written by Engineer von Schuetz, in which the system of construction of chilled cast-iron armor for use in the protection of earthworks and in the making of turrets for land-batteries, as devised by Dr. H. Gruson, some years ago, is described at length, and an account is given of the results of the experiments which have been made, from time to time, by several European governments, to determine its efficiency in resisting the impact of the heaviest modern ordnance. This work has been

translated into English by Commander Grenfell, R.N., and we are indebted to the courtesy of Captain Piorkowski, Dr. Gruson's representative in this country, for an early copy. The subject and the matter of the work are of exceedingly great importance to a nation which, as is the case with our own, is destitute of the most ordinary means of defence in the event of a foreign attack either by land or sea. So serious is our case, that, as remarked in a private letter from the Admiral of the Navy just received and lying under the hand of the writer, if we desire to learn what advances have occurred during the last twenty years, we must go to England, France, Germany, Russia, and even to Constantinople, to study those of the scientific and mechanical departments of the military and naval establishments, and not to our own army or navy. This work of Dr. Gruson would seem to illustrate such advances in the defence of coasts.

Dr. Gruson's armor is simply a chilled cast-iron shield, of which the body is a strong normal iron, while the surfaces on the exposed side are chilled like the 'tread' of an American car-wheel. Such enormous masses are handled, in this case, however, that correspondingly enormous chills are needed, and the manufacture of these plates becomes a matter of extraordinary difficulty and cost. All the resources of a great establishment are drawn upon, and all the ingenuity, knowledge, and experience of an able staff are called out in the prosecution of the work. Chilling, as is well known, probably, to most of our readers, consists in the casting of a peculiar quality of cast-iron, known as 'chilling iron,' in contact with a large mass of cold iron forming that part of the mould which is to form the surface to be chilled. The sudden abstraction of heat prevents the isolation of the carbon in graphitic form, as would otherwise occur in the slow process of cooling naturally, and insures its retention in the combined form, producing a steel layer of considerable depth. The depth so secured is dependent upon the quality of the iron and the efficiency of the 'chill,' as the iron mould is called. The latter must have great thickness and good conducting power to give best results in these applications. Successfully carried out, this process gives a surface harder than tempered steel over a strong and massive interior, the best possible combination, apparently, for an armor-plate.

Dr. Gruson constructs large fixed turrets and land batteries of such plates, and the results of trial indicate them to be more reliable defences than any wrought metal, whether iron or steel, or 'compounded,' yet introduced. The weight of these shields is too great for use in naval construction. The first trials were made in 1869, at the Tegel range, and it was found that all shots fired against the chilled plates broke into fragments, and that the plates bore the hammering with remarkable success. The experimental committee reported that the chilled armor was well adapted for its use. Later trials confirmed this opinion, and the Prussian government at once gave directions for its adoption in important lines of frontier defences, and Austria, Italy, and Holland followed its example. In all these trials the chilled iron shot were found superior, if well made, to any steel shot, except in one or two cases in which makers, like Krupp and the Ternitz company, had either succeeded in securing an exceptional quality of steel, or had found remarkably effective methods of tempering. Plates were tested of from 13.77 to 49.21 inches thickness, and were attacked by guns varying from 6 to 17 inches calibre, throwing shot weighing from 61 to 2,205 pounds. The thickness of plate was usually not far from three times the diameter of the bore of the gun to be resisted. The energy of impact was, in the case of the largest gun, over 47,000 foot-tons; which was only obtained, however, by firing at short range — 150 yards. In all such cases, the shield is subjected to more severe trial than would be likely to be met in actual battle. In trials last year at Spezia, with the 100-ton gun, the shot weighed a ton, and the powder charge 327 pounds, the velocity of impact being over 1,700 feet per second. The maximum penetration was four inches, the plates finally breaking up under repeated blows.

The method of proportioning is to give the plates a maximum thickness in inches equal to from one-fourth to one-third the fourth-root of the energy of the attacking shot measured in foot-tons. The total weight of each plate of which the armor is composed is not far from the weight of the gun expected to be used in the attack.

The system of defensive armor here described is one in which we have a peculiar interest. We have in the United States, in the 'Salisbury' and 'Hanging Rock,' and other brands, the best chilling irons in the world, and it would seem very possible that this may prove to be the best system for our purpose yet devised. It is especially one which we may hope to obtain permanent advantage from, as it seems probable that its advantages over other forms are not likely to be soon lost. R. H. THURSTON.

MENTAL SCIENCE.

Heredity of Mental Traits.

STATISTICAL inquiries have become a recognized instrument of research in mental phenomena. Mr. Francis Galton has set the pattern in his study of the life-histories of English scientists, in his investigation on the heredity of physical and other traits, in his record of development in childhood, in his researches on visual imagery; and his composite photography is simply a 'pictorial average.' Students of educational science have adopted the same plan: the contents of children's minds, the record of the daily progress of infants as affected by heredity and by environment, have been registered in almost every civilized country. The increased activity in this direction is sure to bear good fruit. As soon as modern psychology substituted, for the old notion of a single, uniform, typical mind innately endowed with definite faculties and ideas, and uniformly proceeding in definite grooves, the recognition of the endless diversity in every particular of human faculty, it was no longer sufficient to introspect one mind and record the results of your exploration as psychology: one must now use every possible method, study mind from all its many aspects, call in the aid of the psychologist, the pathologist, the educationalist, the anthropologist, and the sociologist, in order to present a picture that shall have the slightest chance of truly representing the reality. That such statistical researches are unusually open to various kinds of falsification, and are apt to be 'worked' for more than their worth, every one will admit. It requires great insight as well as caution and patience to draw from a series of answers on mental topics such conclusions as are really warranted without going beyond what the facts logically yield, and again without losing the suggestiveness of incomplete records. But all this is an argument, not against the use of such methods, but for the need of *more* such researches.

The French Society of Physiological Psychology — an organization constructed on a much more useful plan than our psychic research societies, and yet including such work as the latter do — have recently issued a circular of inquiry, similar to the 'Record of Family Faculty' of Mr. Galton. This blank they send only to persons of whose reliability, scientific zeal, and accurate observing powers they have abundant evidence. Each such person fills blanks describing a person with whom he is intimately acquainted, another for his friend's father, and a third for his mother. If he have sufficient knowledge of any other member of the family to answer two-thirds of the questions on the blank concerning him or her, he is to add such information. The person whose traits are described must be at least twenty-five years old, so that his character has fully matured. It goes without saying that the records will be treated in the most confidential manner.

The questions are grouped under six heads. I. Education and social position; II. Physical traits; III. Physiological traits; IV. Pathological traits; V. Moral traits; and VI. Intellectual traits. The first group asks for one's religion; his mode of education; his origin, whether of noble kind, wealthy or poor; and so on: it outlines the environment of the individual. Under the second group are questions regarding height; weight; size of head, whether small or large for the height; shape of forehead; color of hair and eyes, etc. The physiological questions test the sensibility of the several senses, — of the eye as to near-sightedness, color-blindness, and the like; of the ear as to fineness; the development of taste and smell, and so on. They also include the temperament, i.e., nervous, melancholic, sanguine, and phlegmatic; the diet, whether a drinker of alcoholic liquors, of tea or coffee, and how strongly addicted to them, and the same regarding smoking; habits of exercise, whether regular, violent, and how taken; general health, whether robust or

not; right or left handedness; the number of hours of sleep and the time of going to bed; whether dreams are frequent, sleep is deep, and so on.

The pathological section aims to record any serious diseases, and especially of the nervous system, through which the person has passed; the disease of which he died, if the record is of a deceased person; the number and sex of his children, and the periods of their birth; the occurrence of congenital defects, and whether they were transmitted to the offspring, and so on. The moral characteristics are more difficult to describe: the plan here followed is to give the recorder the choice between opposite epithets, and at times to include a neutral group. Is the temper of the subject of inquiry joyous, sad, or changeable; calm, or violent? Is he independent in his opinions, or easily led by others? Is he vain, or modest; remarkably truth-loving, or weak in this respect; credulous, or suspecting; selfish, or generous; harsh, or gentle; timid in society, or bold; aggressive in his opinions, or mild? Has he any special talent for music, poetry, the fine arts, science, etc.? Has he pronounced religious sentiments? Is he active, regular in his habits, or sluggish and fitful? Is he intellectually inclined, miserly, or spendthrifty, materialistic, or not? Such is the range of inquiry included in this scheme. The intellectual traits are of a similar nature. The maximum of intellectual work, the manner of working, the nature of the occupations; the strength of the attention, of his logical powers, of his imagination, of his insight, of his memory (and in particular of memory for forms, places, dates, numbers, names, tunes, prose, or verse), of his generalizing power, his classifying talents, and the scope of his mental tension; the soundness of his judgment, the ease of speech, the degree of precocity — these form the last of the group of questions. Throughout, any characteristic specially hereditary, either from the parents to the subject of the description, from the latter to his children, or in a collateral branch of the family, is to be especially noted as such.

To accurately fill out such a blank is by no means an easy matter; it is only of one's most intimate friends (one's family and kindred) that any thing like a complete list can be hoped for. The society does well in asking that where no definite answer is possible the question should be left unanswered; they do not want mere guesses, or phrases that say nothing. M. de Candolle, who has been influential in arranging this list, is much at home in this field of research; and in his seventy-ninth year states that there are thirty-one persons about whom he would be willing to draw up such records. This is an unusual number, and the average scientific observer is doing well if he can furnish ten such records. But even at this rate the society has good opportunities of contributing a valuable addendum to our information on the heredity of mental traits. It would be easy to criticise many points in the arrangement of the questions, and point out omissions and ambiguities, but the main point is the manner in which such answers are used: after the results of this inquiry are published, such criticism will be serviceable in making the next inquiry more thorough and valuable than this.

Recent writers have called attention to the important step in human evolution that occurs when the principles of development pass from the stage of being unconsciously intuited and uncertainly followed, to the stage when they are explicity expressed and purposely aided. If, as many believe, the future of the race is largely in our hands, the knowledge that such researches as those here noticed will furnish, must form the groundwork on which conscious and scientifically-conducted advance will be based.

THE DUCK'S BRAIN. — It is well known that the destruction of the cerebral hemispheres of a bird's brain reduces the animal to a mere automaton. While the functions are all capable of action, all spontaneity is gone. It is a 'sleep without dreams.' M. Ch. Richet has recently called attention to the change in these appearances when only *a portion* of the cerebrum is injured. He uses ducks because the division of their brain is more distinct and the animal less liable to fatal injury by the operation than in pigeons. Only such animals are included in the observation as have recovered from the injuries of the operation. In order to detect the absence of a function as a result of the cerebral lesion, one must know the normal functions of the duck. In the language of the duck, M. Richet detects six cries, associated with pain or fright, with being separated from a companion, with the recognition of a companion, with joy, with taking food, and with being chased by a dog. Add to this the actions occurring in attracting one another and the list is about complete. M. Richet finds that a duck whose cerebrum is partly destroyed acts exactly as a normal duck: an accurate observer could probably not tell which is which. The only difference that was found is this: when a normal duck is driven into a corner, it tries to escape by going to the side of the pursuer; a duck with an injured cerebrum huddles against the wall, and makes no such attempt. M. Richet thinks that this method of escape is really the only intelligent act a duck performs, and that the injury of the cerebrum has thus impaired the highest function; all the rest of a duck's actions are almost entirely automatic, and are performed by lower centres. The experiments accent the importance of correlating the effect of a lesion with the normal intelligence of the animal acted upon.

BOOK-REVIEWS.

On the Relation of the Laramie Molluscan Fauna to that of the Succeeding Fresh-Water Eocene and other Groups. By CHARLES A. WHITE. (U. S. Geol. Surv., Bull. No. 34.) Washington, Government. 8°.

ALTHOUGH it is not distinctly indicated in the title, this is really an important contribution to Eocene paleontology. Twenty-six invertebrate species from the Wasatch group, or lowest division of the fresh-water Eocene beds of Utah, are described and figured. The stratigraphic and geographic range of each species is presented in a table, which Dr. White has made the basis of some important conclusions concerning the relations of the Cretaceous, Laramie, and Eocene strata.

The intimate stratigraphical relation of the Laramie group to the marine Cretaceous series beneath it has been recognized by every field geologist who has studied those strata, and it is this fact, in addition to the discovery of dinosaurian remains in the Laramie, that has led them to range that group as a member of the Cretaceous series. While there seems no reason to doubt that sedimentation was continuous, not only through the marine Cretaceous series, but also from that series into and through the Laramie, it is true that there was at the beginning of the Laramie period a comparatively sudden change in the character of the previously existing molluscan fauna over the whole area which was then occupied by the Laramie waters; that is, at a certain horizon in the unbroken succession of strata there is an abrupt disappearance of all distinctively marine forms, and an equally abrupt accession of brackish-water and fresh-water forms which continue through the whole Laramie group.

On the other hand, similar evidence of continuous sedimentation from the Laramie into the Wasatch group has not hitherto been publicly announced. And wherever later strata have been discovered resting upon those of the Laramie group they have been found to be free from all fossil forms which can be reasonably referred to even a slightly saline habitat, while the Laramie strata contain many brackish-water forms throughout their vertical range.

But Dr. White has been able to show that such unconformities as exist between the Laramie and Wasatch groups are local and unimportant. And, starting with the hope that, although the physical changes attending the deposition of the last of the Laramie beds resulted in the extinction of all the brackish-water mollusca of that group, certain of the fresh-water species would yet be found to have continued their existence into the Wasatch epoch, he has proved that this is actually the case.

In other words, we seem to have conclusive proof that there is a complete and unbroken stratigraphical series in that western region, extending from the Middle Cretaceous to the top of the Eocene, and aggregating nearly or quite two miles in thickness. A remarkable fact connected with the production of this great series is that, while sedimentation was evidently not materially interrupted in at least a large part of the area within which those deposits are now found, the aqueous life was changed first from that of a purely marine character to that of alternating brackish and fresh waters, and finally to that of a purely fresh-water character; that is, the waters in which this series of strata were deposited were first

marine, then alternating brackish and fresh, and finally wholly fresh. This, of course, implies the occurrence of great physical changes upon the North American continent during the Cretaceous and Eocene periods, which, however, did not interrupt sedimentation in a large part of its interior.

Dr. White has also done stratigraphic geology an important service in his concluding remarks upon the value of fresh-water fossils in geological determinations.

"The differentiation of the mollusca into generic, family, and ordinal groups, and the diversification of specific forms among these groups, are immensely greater in marine waters than in any other. In brackish waters it is much less than in the open marine, and in lacustrine waters the minimum of differentiation is found. The large collections of fossil mollusca which have been made in different parts of the world indicate that this slight tendency to differentiation among fresh-water mollusca has always obtained in past geological time; also, that types once established have persisted through a long series of geological periods. Therefore it has become known that fossils of fresh-water origin are of little value, compared with those of marine origin, as indices of the true geological age of the strata containing them. In consequence of this, the real value of fresh-water fossils as aids in the study of stratigraphical geology has been underestimated. While it is admitted that these fresh-water forms are of little value in determining the geological age of strata, they are really of as great importance in the study of local, and even of continental, geology as are any other fossils. Indeed, it would be quite impracticable to ascertain whether the waters in which formations have been deposited were marine, brackish, or fresh, except by the character of the contained fossils.

"Fresh-water formations of considerable extent can only be produced upon continental areas, and they consequently record phases of continental history of which marine formations give no indication. In western North America the fresh-water deposits rival in extent and thickness the great marine formations; and it would have been impossible to arrive at the knowledge of them which we have now attained except by a study of their fossils. Each of these great lacustrine formations has its own distinguishing fauna, the uniform character of which over great areas is quite remarkable. So large has been the area of some of the fresh-water seas in which these deposits were formed, and so uniform the conditions under which they existed, that the geographical distribution of species in them has been nearly or quite as great as the average of that of marine mollusca. For example, some of the species of the Laramie group have been found at points more than a thousand miles apart; and in the fresh-water Eocene groups the molluscan fauna is practically identical at points as much as 200 miles apart."

The Margin of Profits. By EDWARD ATKINSON. New York, Putnam. 12°.

MR. ATKINSON'S writings on practical economy are among the best that we have. They are always interesting and suggestive, and frequently contain information and advice of much value to those for whom they are intended. They are not original in a scientific sense, and do not profess to be, Mr. Atkinson being a man of business rather than of science; yet all his arguments rest on a scientific basis, and on carefully collected statistics. He is, moreover, in hearty sympathy with the toiling poor in their efforts to improve their condition in life — indeed, most of his writings are inspired by this motive; yet he freely criticises them when he thinks their efforts are in the wrong direction.

The book now before us contains an address delivered before the Central Labor Lyceum of Boston, together with a reply made on the same occasion by Mr. E. M. Chamberlin, and Mr. Atkinson's rejoinder to the same. The special object of the work is to show, first, that the margin of profits, that is, the share of the capitalist in the products of industry, is much smaller than workingmen generally suppose; and second, that the progress of industry and the increase of capital, while benefitting the capitalist, of course, benefits the laborer far more. To prove and illustrate the first of these propositions, he cites the example of the cotton manufacture, in which the amount of capital used is larger in proportion to the product than in any other industry; so that here, if anywhere, we might expect the profits to be unusually large. Yet, according to Mr. Atkinson, who is thoroughly informed in the matter, the profits are but a very small portion of the cost of the goods. He says: "When you buy 40 yards of cotton cloth at $2.50, you pay the owner of the mill 15 cents profit, but you also pay about 15 cents more to other people for profit; that is, 30 cents profit in all; and you pay $2.20 directly for labor" (p. 28). This statement he proves by an analysis of the process of production, illustrating the same by a chart.

He then goes on to show how greatly the working classes have gained by the improvements that have taken place in production and the consequent increase of capital. He gives it as his opinion, and economists generally hold the same view, that "there has never been a period in the history of the world in which there have been so many important new inventions or so many applications of previous inventions, all tending to human welfare, as in the last twenty-five years" (p. 109). And these improvements, though at first chiefly beneficial to the few, are now, he thinks, tending rapidly and largely to the benefit of the many. He cites some statistics showing that during the past twenty-five years the cost of living has been greatly reduced, while the wages of workmen have largely increased.

Mr. Chamberlin's reply to Mr. Atkinson is very feeble indeed, not one of his opponent's arguments being met, nor any new ones of value advanced. That Mr. Atkinson's views are in the main sound there can be no doubt; yet the scientific relations of capital and labor are not yet thoroughly understood, and until they are we cannot tell precisely how improvements in production and increase of capital affect the different portions of society. Mr. Atkinson is doing important service, however, in calling attention to the service rendered to society by capitalists, inventors, and other brain-workers, and which laboring men are liable to overlook or underestimate. He gives also valuable hints on the subject of personal and domestic expenditure, showing that the poorer classes might save much more than they now do without diminishing their present enjoyment in the least. The whole book, in fact, though containing little that is new of a scientific character, cannot fail to be of use to workingmen, as well as to all others who are studying the labor question from a practical point of view.

Die Klimate der Erde. Von Dr. A. WOEIKOF. 2 vols. Jena, Costenoble. 8°.

DR. WOEIKOF, professor of physical geography in the University of St. Petersburg, is well known to American meteorologists as the author of the general explanatory essay in Professor Coffin's 'Winds of the Globe,' published after the death of the latter by the Smithsonian Institution. He has also been a frequent contributor to the Austrian and German meteorological journals and to other scientific periodicals outside of Russia, and his essays on the climate of the glacial period have attracted much attention from geologists. He has travelled and observed widely abroad, as well as read exhaustively at home. Students of physical geography are therefore to be congratulated that he has condensed the results of his labors in a general work on the climates of the earth, and also that an authorized German translation of the Russian original has appeared; for it is a positive loss to science when an experience as wide and well trained as Dr. Woeikof's is not recorded as far as may be in transmissible form.

The first volume of the work includes a series of chapters on matters of general importance, several of which have been republished elsewhere, so agreeable are they in style and treatment. The chief headings are, 'Pressure and Winds, including a Consideration of Temperature Changes in Vertical Currents;' 'Atmospheric Moisture and Precipitation;' 'Influence of Snow and Ice on Climate;' 'Temperature of Bodies of Water and their Climatic Influences;' 'Daily Variations of Temperature, Moisture, and Wind;' 'Variation of Temperature with Altitude, with Particular Regard to the Effect of Topographic Form on Temperature Changes;' 'Effect of Climate on Vegetation and of Vegetation on Climate;' 'General Statement of the Distribution of Temperature and Pressure over the Earth.' There is nothing of text-book style in these chapters: they are rather essays than lessons, fit for reading by the well-informed meteorologist rather than for study in

school. Reading of this sort is greatly needed in all branches of science, and nowhere more than in meteorology. Look, for example, at the account given of the effects of melting ice and freezing water on the temperature of the adjacent air. The effects appear either in time alone, or in both time and place. When lakes freeze, they retard the early winter fall of temperature, and when they melt they retard the spring warming by an equal amount: this effect is constant in place, but varies in time. On the other hand, when snow falls, the liberation of energy in its freezing affects the temperature of the air at some distance above the earth's surface, making it warmer than it would have been if condensation had not taken place; but the same snow, melting afterwards on the ground, keeps the air there from warming as much or as soon as it would had the snow been absent. Here, then, is an effect that varies in place as well as in time. It is like carrying ice from New England to India: if this once famous industry had been extensive enough, it would have raised our mean temperature, and lowered that of the torrid zone where the ice melted.

The second volume of the work is given to a general geographic account of climate. Here a comparison naturally arises with Hann's 'Klimatologie,' that appeared a few years ago. The subjects treated are identical; the difference is only in the plan of treatment and in degree of emphasis given to one part or another by the two authors. Dr. Hann made free use of original accounts by travellers and foreign observers, and inserted abstracts of their writings in smaller type, after presenting his own general statements; he also included the various climatic tables in the text, alongside of the paragraphs that they illustrate. Dr. Woeikof reduces the records that he consults to common form, and postpones all tables to the end of the book, where they appear with numerous diagrams that have small representation in Dr. Hann's book. Preference between two methods such as these is probably a matter of taste, my own being for that followed by the Austrian author; but the other will doubtless find equal approval. The absence of sufficient reference to earlier authors makes both books less useful than they might have been; but the insertion of the references would have materially increased the size of the volumes, already large, and I believe it was for this reason that they were omitted.

The duplication caused by the almost simultaneous appearance of these two books on one subject can only be regarded as a great advantage. They were independently prepared by leading specialists; and the careful reader, who wishes to think as well as to quote, will gain a solid, stereoscopic comprehension of the subject by approaching it from these two slightly different points of view.

Foods and Food Adulterants. Part I. Dairy Products. (U. S. Dept. Agric., Bull. No. 13.) Washington, Government. 8°.

THIS bulletin, which has been prepared by H. W. Wiley, chemist, is devoted chiefly to a discussion of the best methods of detecting the adulteration of dairy-products, that of butter being treated with greater detail than any other. During the past year the division of chemistry has been supplied with apparatus for photo-micography, and most of the illustrations, twenty-four in number, are the work of the division. Great benefit has been derived from this method of fixing the photographic appearance of the crystalline character of butter and butter substitutes. The illustrations show the crystalline appearances of butter, beef-fat, lard, butterine, and oleomargarine, and are well executed. The bulletin contains the text of the act of 1886, passed by Congress, defining butter, and imposing a tax upon, and regulating the manufacture, sale, importation, and exportation of, oleomargarine; also a detailed history of artificial butter from its first manufacture by Mége-Mouriéz, in 1870, to the present time. The writer of the bulletin believes, that, while a great deal of artificial butter has been thrown upon the market, that has been carelessly made, and therefore harmful to the health, still a butter substitute, made carefully out of the fat of a perfectly healthy bullock or swine, is not prejudicial to health. This opinion is supported by quotations from the leading authorities, such as Professors Morton, Chandler, Barker, and others. The best methods of butter and milk analysis are described in detail, both microscopical and chemical. Other bulletins are being prepared, and will soon be issued, treating of condiments, sugar, sirup and honey, drinks and canned goods, flour and meal, tea and coffee, and baking-powders.

Milton's Paradise Lost. Books I. and II. Ed. with introduction and notes, by M. MACMILLAN. New York, Macmillan. 16°.

THE difficulties of Milton's works are so great, owing to the Latinized structure of his style and his many learned allusions, that they require a commentary almost as much as the ancient classics do. Nor have our scholars neglected to provide such helps; yet for school purposes most of them leave much to be desired. The little book before us is one of the best works of the kind that we have seen, and will help to make the reading of Milton both easier and pleasanter. It is confined to the first two books of 'Paradise Lost,' which the editor rightly considers the grandest portion of Milton's works. The notes are accurate and very exhaustive, as may be seen from the fact that they fill eighty-four pages of the volume, while the text fills only fifty-four. Almost every thing is explained in them that a student would need to have explained, and the explanations are simple and clear. An introduction of moderate length gives an account of the conception and composition of 'Paradise Lost,' together with some judicious criticisms on the poem. The book may be heartily commended for educational use.

Schiller's Wilhelm Tell. With Introduction and Notes by G. E. FASNACHT. London, Macmillan. 24°.

Schiller's Wallenstein. Part I. Das Lager. With Introduction and Notes by H. B. COTTERILL. London, Macmillan. 24°.

MESSRS. MACMILLAN & CO. have, in the two books named above, made valuable additions to their Foreign School Classics series. The Wallenstein is preceded by a well-written historical sketch of the origin and character of the thirty-years' war. The difficulties in reading Wilhelm Tell do not lie in Schiller's style and diction. These are throughout transparently clear. Not so the subject-matter. The reader's progress is delayed at almost every step by historical allusions, provincialisms, topographical and meteorological terms, for the elucidation of which even the advanced student needs to have a complete cyclopædia at his elbow. All this reference-hunting involves a great waste of time, and this little edition of the work has been edited with the view to placing these side-lights at the disposal of the reader.

Higher Algebra. By H. S. HALL and S. R. KNIGHT. London, Macmillan. 16°.

THE present work is a sequel to the author's 'Elementary Algebra for Schools.' The first few chapters are devoted to a fuller discussion of ratio, proportion, variation, and the progressions, which in the former work were treated in an elementary manner. The discussion of convergency and divergency of series always presents great difficulty to the student. To render this the more intelligible, the authors have introduced a short chapter on limiting values and vanishing fractions. In the chapter on summation of series they have laid much stress on the method of differences and its wide and important applications. Permutations and combinations and the theory of probability have received due attention, also the theory of determinants and their applications. The last chapter contains all the most useful propositions in the theory of equations suitable for a first reading.

Naturae Veritas. By GEORGE M. MINCHIN. London, Macmillan. 16°.

WE learn from the author's preface that in this poem he has related certain things, which, in a temporary absence from this earth, he received from a being who, having completed the change of existence, had attained to a knowledge of the universe far transcending the capacity of man. The poem is descriptive of the author's supposed stellar visits in quest of information, which should lay at rest his doubts in regard to the dissipation of energy. Unfortunately the journey was without result.

The Owens College Course of Practical Organic Chemistry. By J. B. COHEN. London, Macmillan. 16°.

THIS little book on organic chemistry will be received with favor, doubtless, and has already received the high indorsement of Prof. Henry E. Roscoe and Prof. C. Schorlemmer. Any course of practical organic chemistry leading up to original work must mainly consist in a careful preparation of a well-selected series of organic compounds. Dr. Julius Cohen has in this little book collected such

a series; and doubtless the book, which is a novel one, will prove useful alike to professors, assistants, and students. Its primary purpose is that of a laboratory guide.

Four Figure Mathematical Tables. By J. T. BOTTOMLEY. London, Macmillan. 12°.

THIS is a series of mathematical tables comprising logarithmic and trigonometrical tables, and tables of squares, square roots, and reciprocals. In an appendix are contained a number of useful formulas and numbers, especially for those engaged in work in physical laboratories. The book is compiled by a lecturer in natural philosophy in the University of Glasgow.

NOTES AND NEWS.

IN order to expedite the publication of short articles upon astronomical and meteorological subjects which may be prepared at Harvard College Observatory, it has been decided to print them as successive numbers of a series, which will constitute the eighteenth volume of the 'Annals of the Observatory' when a sufficient amount of material has thus been collected. Each number will be published and distributed soon after it has been prepared.

— During this month will appear, under the editorship of Dr. G. H. Rohé, a quarterly journal, *The Climatologist*, devoted to the consideration of questions in the domain of medical and sanitary climatology. As there is at present no other journal in the world exclusively occupying this special field, the editor and publishers believe that there is room for such a publication. Each number will contain forty-eight quarto pages of reading-matter, the subscription price will be fifty cents per year, and the place of publication, S. E. Cor. Baltimore and South Streets, Baltimore, Md.

— Dr. John Vansant of the United States Marine Hospital at St. Louis claims to be the first to have taken photographs by the light of fireflies. He placed twelve fireflies in a three-ounce bottle, covering its mouth with fine white bobinet. The average duration of the flash of each insect was half a second, and the luminous area on the abdomen was about one-eighth of an inch square. The time of exposure was fifty flashes.

— Lieut. J. F. Moser, U.S.N., commanding the Coast Survey steamer 'Bache,' has just submitted a report of the hydrographic work executed by that steamer from Cedar Keys southward to a point off Chasahowitzka River, and the finishing of the hydrography from Cape Romano to the delta of the Mississippi. He refers to the great difficulty of running triangulations, owing mainly to the obscurity or entire absence of former triangulations, or other ear-marks of the locality to be surveyed. St. Martin's Reef was found to continue as far north as Homosassa, thence trending eastward to join the shallow waters of Crystal River. It is on the Florida banks, of which St. Martin's Reef forms an inshore part, that many of the commercial sponges are taken, and a large number of vessels are yearly engaged on the work. The tides in this locality were found to be easily affected by winds, causing great irregularity in their range, stand, and times of movement. The coast was found to be low and rocky, and the entire bottom covered with porous rock. The anchorage off St. Martin's Reef is good and safe in any weather except a hurricane. Lieutenant Moser says the country is dreary, desolate, and uninhabited, and the coast-line consists of fringing islands, thickly covered with mangrove. On these islands oysters are found growing in trees, the spawn having attached themselves to the branches at high water and developed into oysters. Bird-life was not abundant, even sea-gulls being conspicuous by their absence. Rail and blue and white herons were found, but even these birds have been driven away by the plume-hunters.

— A. Auwers has thoroughly discussed the alleged periodical changes of the diameter of the sun, and finds that in fact they do not exist. His researches, which are founded on 19 series of observations, — 12 of which refer to the horizontal diameter, and comprise 21,000 observations, while 7 refer to the vertical diameter, — show that the periodical changes are due to the influence of the temperature upon the instruments with which the observations were made, and that for this reason the period corresponds to that of the annual period of temperature.

LETTERS TO THE EDITOR.

Experimental Physics for Schools.

FOR years one of the requirements for admission to Harvard College has been such knowledge of physics as may be obtained from the study of any one of certain well-known elementary text-books. To this requirement is now added the study of a certain astronomical text-book, but as an alternative to both the text-book physics and the astronomy there is recommended a course of study in physics involving considerable laboratory work on the part of the pupil, supplemented by instructions from a text-book or a course of lectures.

Two questions suggest themselves to the teacher of physics when he finds himself met by the proposition to give laboratory practice to a whole class: 1st. Is this desirable if practicable? 2d. Is it practicable?

Without undertaking to discuss at large the theory of a liberal education, we can note a few considerations which will enable us to answer the first of these questions with some confidence: 1st. Physics is studied partly for training and partly for information. 2d. Text-book physics alone gives but little training that cannot be given by arithmetic, algebra, and geometry, all of which studies are pursued by the pupil before he enters college. 3d. Physics as taught by the laboratory experience of the pupil gives a kind of training that is not given by any course of study *required* for admission to Harvard College or, perhaps, any other college in the country. This training is partly of the senses and partly mental. It is true that many book-studies educate the senses to a certain extent, and the logical faculties, but unfortunately it is possible for a person who is observing and logical in things which he is in the habit of studying to be quite the opposite in dealing with things which do not habitually occupy his mind. Now, laboratory physics is the only elementary study for admission to Harvard College that requires the student to look beyond the pages of a book, and although most students do look at other things than books, they are not in the habit of *studying* things outside of books. 4th. The information given by the text-book alone is wide but superficial and vague. It is like that knowledge of a country which one may get by travelling rapidly over it on a railroad train. 5th. The information given by laboratory practice alone is definite but narrow. It is like that knowledge of a country which one would get if he tried to go over the whole of it on foot. 6th. Most students show far more interest in laboratory work than in the study of a text-book, even when the same subjects are dealt with in both cases. Much of the repugnance which many students feel for physics as they study it comes from the almost painful effort of the imagination to body forth the things described in the text-books, and which might be seen directly and handled in the laboratory.

From these considerations we reach the conclusion that the course which Harvard recommends to preparatory schools is desirable, if practicable, viz., to have the pupil study intimately certain topics by the laboratory method, and to enlarge upon, apply, and connect the knowledge so gained, by means of a text-book or a course of lectures. In the opinion of the writer, a course of lectures sufficiently extensive and systematic to take the place of a text-book for this purpose is beyond the present powers of most preparatory schools.

It may be hoped that by following such a course in physics the student will escape, on the one hand, a condition of blind and helpless dependence upon text-books, and, upon the other hand, the scarcely less unfortunate state of self-sufficiency which cannot or will not profit by the literature of the science.

Harvard University has issued for the use of teachers engaged in preparing students for its college classes a pamphlet giving a list of forty laboratory exercises, with specifications of the apparatus and materials to be used in these exercises, and with directions for their performance, or references to manuals giving such directions. These exercises are to be performed by the pupil. To speak cursorily, they deal with certain distinctive characteristics of the solid, liquid, and gaseous states of matter, the determination of specific gravities, the first principles of statics and dynamics, evaporation and boiling, the determination of the fixed points of a thermometer, expansion of solids and gases, specific heat, latent heat, velocity of sound, interference of

sound-waves, photometry, plane mirrors, converging lenses, lines of magnetic force, construction of galvanic cells, action of electrical currents upon magnets, electrical resistance of wires, battery resistance, construction of electro-magnets. Nearly all of these exercises are of a quantitative character, requiring measurements of some kind. It is expected that they will be liberally supplemented with other less formal experiments, not necessarily to be performed by the student, such as are described in ordinary text-books, with problems, and with general teaching, all of such a range and character as to give effect and continuity to the course.

In considering whether such a course of physics is practicable there are several points to be looked at: —

1st. The material equipment required. It will not in general be practicable for a teacher to give proper attention to more than twelve students working in the laboratory at the same time. The cost of the *portable* apparatus and material needed to enable twelve students to follow the course marked out in this pamphlet, each working upon the same experiment at the same time but in general independently, may be any thing from $250 to $450, according to the amount of time and skill the teacher can devote to its preparation. I think this part of the equipment, with apparatus ready made, can be bought outright for the larger sum mentioned. There will be needed also two strong tables, each about twelve feet long and three feet wide, one or two sinks with water-faucets, and for each student a supply of gas for a Bunsen burner.

For a school already well supplied with the ordinary *illustrative* apparatus, the total cost of adding the material equipment for the laboratory course, on the scale supposed, may range from $400 to $800. If only one or two students are to be provided for, the cost may be not more than $50 or $100.

2d. The demand upon the pupil's time. In the summer of 1886, Harvard sent out to a large number of teachers of physics in preparatory schools a circular requesting answers to certain questions, one of which related to the amount of time devoted to this study in their respective schools. About eighty replies to this circular were received, and the conclusion from these replies was, that, in laying out the elementary physics courses for admission to the college, we might assume that the pupil would have for this subject the equivalent of one school exercise of about forty-five minutes daily for one school-year of thirty-five or forty weeks, with some hours of study weekly out of the school-room. The proposed course has been planned in accordance with this estimate. This is probably about as much time as will be required for elementary French or elementary German in fitting for Harvard, and not more than one-half as much as most candidates have given to prescribed Greek, or one-third as much as they have given to prescribed Latin.

3d. The arrangement of hours. Experience in the Harvard physical laboratory, with a course very similar to the one proposed for the schools, dictates the suggestions, 1, that one school-hour per week be given to a preliminary explanation, and perhaps hasty performance by the teacher, of the exercises presently to be undertaken by the pupils, the whole class being assembled for this exercise; 2, that each pupil have two consecutive school-hours per week for the actual performance of the formal experiments of the course, the class, if large, being divided for this purpose into sections of not more than twelve; 3, that the other two school-hours per week be devoted to the supplementary work of the course with the whole class assembled. In order that the time alloted for the laboratory work may be sufficient, the student should be required to plan his work and his note-taking, so far as this is practicable, before coming to the laboratory.

4th. The demand upon the teacher's time. Scholars so young as those will be who may take this course need much direction in their laboratory work. The teacher should be in the laboratory whenever work is going on there. The preparation and care of apparatus and the proper supervision of the students' note-books will take much time, especially at first. After every thing has settled into regular working order, it may require six or eight hours more, weekly, of the teacher's time to conduct a class of thirty or forty students in the experimental laboratory course than to conduct a class of the same size in the text-book course, which is to be the alternative.

5th. The fitness of teachers for such work. Probably only a small proportion of the teachers of physics in the preparatory schools have had such a training as would enable them to arrange and conduct the proposed course without considerable effort and some mistakes. For the first year or two crude work is to be expected, but teachers who are possessed of some mechanical skill, a good general knowledge of physics, considerable energy, and a willingness to think, will quickly become accustomed to the duties of the new course.

Just how great the difficulties which have here been touched upon will appear to the preparatory schools the writer is unable to foresee, but there can be little doubt that the larger schools which send boys to Harvard will, in general, speedily adopt the experiment method in preparing boys in physics. Last July about eighty candidates presented themselves for the entrance examination in the experiment course, and, although this course as now laid out will be more severe than that which some schools have followed during the past year, it is unlikely that any school having once undertaken the experiment course will abandon it for the text-book alternative.

The enthusiasm with which many teachers welcome the opportunity to follow the experiment method is very striking, and encourages the hope that the day of perfunctory cramming in physics merely for the purpose of getting into college is nearly over.

E. H. HALL.

Romantic Love and Personal Beauty.

THE above subject in its varied aspects, to which the review of Mr. Finck's book in *Science* has called attention, must be regarded by all thoughtful men, and above all by the biologist, as one of great, possibly unsurpassed interest to mankind. The question in its broadest aspect comes to this: How are the interests of mankind dependent on conjugal mating and the circumstances under which this is brought about? As no one can pretend to see the whole truth on such a subject (or indeed any other of comprehensive range), I shall give the results of my own observations and reflections, with a view of drawing increased attention to a subject of such transcendent importance. While every one, in some vague way, recognizes the importance of the step taken when two human beings agree to join their fortunes for life, the multiform implications of such an act require for their comprehension a biological knowledge that but few, in the present state of civilization, possess.

Mr. Finck, after enumerating the characteristics of romantic love, grants that many of these are found in the lower animals, but at the same time leads us to believe that romantic love is wholly a modern growth, or that it had no genuine existence, at all events, previously. Is this position consistent for an evolutionist? If it existed lower in the scale than man, it seems very unlikely that it should cease to exist in the higher form. Mr. Finck seems to have rather overstated the case. That it never had complete development till modern times, that it was smothered, dwarfed, or perverted, we will freely admit; but we must deny that it is purely a *new* thing. Why is it, as we know it, modern in its development? Because never before was the altruistic conception of human conduct fully developed. That a man should sacrifice himself for an inferior was utterly opposed to all ancient ideas. When this conception took shape it at once began to appear that woman, being the weaker physically at least, demanded, in harmony with the altruistic principle, the service and sacrifice of the stronger, hence gallantry, etc. Formerly this was but an undeveloped germ in the breast of man; but it was there, however, and is not an absolutely new thing. In a word, romantic love demands a relatively high moral development for its vigorous growth. Perhaps Mr. Finck would really contend for no more than this.

Darwin, consistently with the great influence he assigned to sexual selection in his scheme of organic evolution, included man with other animals. He pointed out that "the men who are rich through primogeniture are able to select, generation after generation, the more beautiful and charming women; and these [he adds] must generally be healthy in body and active in mind." No doubt this explains a great deal, but it does not explain the origin of beauty in man or woman. In explaining the high average of comeliness and the relative frequency of beauty in human beings in America, this factor enters very largely into the explanation both of the preservation and increase of beauty of form and expression,

inasmuch as in no part of the world is there such unrestricted conjugal choice. But how does beauty originate? Sometimes suddenly, the offspring being incomparably superior to the parents; more frequently by gradual improvement, though certainly very pronounced in a large proportion of cases. A Darwinian would say this was owing to fortuitous variations and natural selection. But these 'fortuitous' variations Darwin did not attempt to explain. To do this is the task of modern evolutionists. It must be a gradual process so far as details are concerned.

In a paper read at the recent meeting of the American Association, I traced the influence of monotony in the environment, among other causes, in determining race degeneracy in a small and isolated community in the Bahama Islands, and endeavored to place this upon a scientific foundation. In a somewhat elaborate paper just read before the Canada Medical Association, I have advanced a new theory as to nutrition; viz., that the nerve centres are constantly exercising an influence over the nutrition of all the tissues of the body through the nerves distributed to them. This view supplements and explains that maintained in the first paper. It seems to me that it throws an entirely new light on the whole subject of evolution, supplies, in fact, a missing link in the explanation, — at all events for all animals with a nervous system, — and accounts for the origin of variations as, so far as I know, no other theory does. It furnishes what the Lamarckians have lacked but never supplied. I cannot, of course, give in this letter the facts on which this law is founded, but may say that they are of a threefold character: clinical, pathological, and physiological.

The form, etc., of every organ depends upon its mode of growth, upon its nutrition. According to the above theory of a constant neuro-trophic influence, the nutrition is every moment dependent on the nervous system. Now as it is through this system the organism is brought into relation with its environment, so through it the environment is registering its effects every moment. One thing seems to be settled in regard to beauty: it cannot originate when the existence is a purely vegetative one, devoid of all excitement of a psychical kind. That beauty is most frequent among the classes of the community in easiest circumstances, with opportunities for varied excitement of mind (and consequently of body), can thus be understood. That the mental mood causes the face to vary very much in expression is patent to all, and is understood by the influence of the mind over the muscles through nerves by influences radiating from the nerve centres. My theory goes much further than this, however, and assumes a constant influence of the nervous system directing the nutrition of every cell and so the form of the entire organism. By such a view we are able to understand how the young being *in utero* can be moulded to beauty or the reverse, by the environment of the parent. It may be long before we are able to work out the details, but we must not be hopeless even as to that.

This then is a physiological explanation of evolution. Now, although on reflection it must appear that all final explanations of evolution must be physiological, it is remarkable that scarcely a single physiologist has undertaken the solution of any of its problems. I hope to be able in the near future to elaborate the subject from the physiological standpoint and along the lines indicated above. And it is because this explanation seems to bear so directly on vital questions like those treated by Mr. Finck that I write to *Science* on the present occasion.

It is evident that for the best results to mankind there must be the freest choice in conjugal mating. We think biology has now advanced far enough to say of certain persons that they cannot mate without danger of deterioration in the offspring, e.g., in the case of those with a pronounced consumptive or strumous ancestral history; and it says much for the character of those who, with this fear before them, have sacrificed the prospects of conjugal happiness for a time, for the good of the race, by remaining in celibacy. An accomplished, experienced, and wise physician, well educated in the principles of heredity, might often, if consulted, be justified in saying nay. That he could say that any particular union is the best possible, is going far beyond our present biological knowledge.

With the inferior animals we can predict results as to offspring with a certainty that is remarkable. But with man the environment is so much more complex, from his more involved social life, from his high cerebral development (psychical life), that it is impossible to estimate all the factors in the environment; and, if we could, we do not yet know exactly how they act. But nature has not left man without a sure guide. By man's instincts (intuitions) light is supplied, in each instance, that science can as yet give only as general principles. The individual is a light unto himself, provided that he has lived an honest, pure life.

For myself, on this point, I hold the strongest views. My theory as to falling in love would be something to this effect: there are in normal minds the elements of an unformed ideal, which takes definite shape when the person answering to that ideal appears, provided there be no interfering causes. This ideal appertains rather to *type* of individual than to any special person; i.e., there is the potential capacity to love one of many individuals of the type, and the exact individual of this type chosen may be a fortuitous matter. Good results, if not absolutely the best, follow in such cases, no matter which one of the type-class is chosen. As Carlyle said, "No man can love but once, and some not then." The choice of those of opposite tendencies, etc., results in a large proportion of cases in the highest good alike to the individuals themselves, their offspring, and the race. Man and woman in the conjugal state should be the one complementary to the other. The education of the sexes should lead to as much differentiation as possible, in order that the total energy available for the race may be maximal. The education given by parents and the general education of the public should be such as to allow of the highest degree of free, intelligent conjugal choice. If this is accomplished the results as regards beauty will be equally good with those in other directions. I seem, Mr. Editor, to be just getting into the subject, but I fear I have already taken up too much of your space; the importance of such a question must be my excuse.

T. WESLEY MILLS.

Physiological Laboratory, McGill College,
Montreal, Aug. 29.

The Study of Geography.

THE efforts of the Royal Geographical Society towards the improvement of geographic teaching in England, as recently described in *Science* by Mr. Keltie, deserve particular attention, both from the success already attained and from the need of going still further. The success is conspicuous, if measured only by the recognition and opportunity given to Mr. Mackinder as reader in geography at Oxford; and the advance already gained in the character of models, maps, and illustrations is admirable and enviable; but I cannot help feeling that the shortcomings of the scheme are also apparent. It seems to me that geography itself needs as much attention as the means of teaching and illustrating it: the principles to be taught and the facts to be illustrated need fuller discussion and better choice than they have yet received. But Mr. Keltie, in his recent article in *Science*, says: "Of what is known as physical geography — the topographical surroundings of humanity — there is not much to complain: its facts and principles are pretty well known, and fairly set forth in numerous text-books. It is when we come to apply these facts to humanity, and deal with their bearings on the development of man in communities, that we find so much to desire." I sympathize fully with the second sentence of this quotation, but not at all with the first. Certainly much is still to be done in recognizing and illustrating the bearing of geographic facts on the development of human communities, but quite as much, or more, is yet to be accomplished in the careful study of the facts themselves. Mr. Mackinder, in his address to the Royal Geographical Society (*Proceedings*, March, 1887), includes these geographic facts under 'physiography,' and their relations to humanity under 'physical geography;' but the illustrations that he presents are chiefly of the latter subject, and the tendency of the Society, judging by the character of its Journal of former years and its current Proceedings, is, with small exception, in the same direction. It should be noted, however, that Mr. Mackinder gives much more importance to geologic origin of geographic forms than has been usual. Now it may be true, though I think it is not, that enough is known of physiography to serve the wants of physical geography; but it is undoubtedly true that physiography as a science in itself is in a most immature condition, and is only in recent years obtaining

recognition. Physiography now is in the low position that natural history occupied in the first half of the century, when its text-books gave brief descriptions and pretty little wood-cuts of a great variety of forms, dwelling on their slight differences more than on their great resemblances. In a score or more of years, physiography will be fortunate if it attain as high a position as is now held by biology, the successor of the old natural history, in which a few forms are first studied minutely, and the knowledge of detail thus gained is broadened by giving emphasis to the resemblances that relate these few types to all the rest of the animal and vegetable world. As far as the economic relations of plants and animals to human history are concerned, some might be content with such a statement as 'a horse is a horse;' but the study of zoölogy for itself, without regard to its relations to history, must regard a horse as a highly specialized form of a general type, and must discover how his specialization was accomplished.

Physiography must make the same advance. It might serve the needs of physical geography if physiography made no distinction between a new plain smoothed by constructive process and an old base-level plain smoothed by destructive process; but to physiography itself the omission of this vital distinction is absolutely fatal. Placing such apparently similar forms together would involve the same order of error as that of classing whales with fishes, or of grouping the unwrapped cephalopods of the mesozoic with the straight forms of the low paleozoic. Time must be recognized as an element in geographic description even to a greater degree than it has been by Prof. Archibald Geikie in his study of 'geograpic evolution;' for topographic development is the key to a real understanding of the forms of the land about us. Physiography must, moreover, follow the example of biology in studying its simpler type-forms carefully before attempting to understand the complex associations of forms that make up a country or a continent.

Continental homologies have gone far enough already, if indeed not too far, in the present state of knowledge: attention should be directed instead to the minute morphology and systematic development of individual topographic forms. The difficulties of such work are great, especially in teaching; for while it is admitted that 'seeing is believing,' and methods of instruction in chemistry, physics, and organic natural history are all remodelled with this principle in view, geography can at best secure but an imperfect application of the principle, and has to get along with maps, views, and models, instead of studying actual forms themselves. Maps are nearly always on too small a scale, and too poorly drawn to show what ought to be seen. Photographs are of course extremely useful, but they generally include too many varieties of form, and present too much detail, to serve best in elementary instruction; and they are as a rule taken with a geographic rather than a physiographic object. Illustrations in books of travel are too often of no scientific value: the traveller is generally an explorer instead of a geographer, and the artist too often stays at home. Most of Holzel's oleographs are admirably artistic, and all are highly valuable, and they probably come as near to being 'types' as any thing published. The illustrations in the reports of our Geological Survey are also most excellent in this respect. Models are too often merely copies of actual places that have been, for such a reason as complexity of structure or the like, chosen for this kind of illustration: the model of Monte Rosa mentioned by Mr. Keltie, excellent as it must be as the work of so artistic a geologist as Professor Heim, and so appreciative a topographer as Herr Imfeld, must have about the same relation to the needs of a class in physiography as a menagerie would have to the needs of a class in biology, or as Leverrier's computations about Neptune would have to a class in mathematics. Mr. Keltie recognizes, however, that, for teaching purposes, "it should be remembered that it is not extraordinary features that are desired, but typical aspects of the earth's surface," but he does not say where we shall find a scientific and sufficient investigation of the forms that are to be chosen as 'typical aspects.' There is no such investigation. The absence of any thorough and consistent physiographic terminology at once points out the immaturity of this study. Beginnings may be found here and there, but certainly not in 'numerous text-books.' The Sixth Annual Report of the Geological Survey, just issued, contains, for example, a number of illustrations that will be seized upon when the proper text-book appears. The choice little woodcuts on page 229, entitled 'Topographic Old Age,' and 'Topographic Youth,' are particularly good, but these terms will certainly be new to most readers.

Let me repeat, therefore, that while the principles of physiography are coming to be pretty well understood, the facts have yet to be set forth in their proper light, and the world must be explored over again to find them. Let any one who doubts this read over the ordinary books of travel and the older geological and geographical reports, and see what sort of a physiography he can make out of them. Before the methods of teaching physiography are perfected, before the proper illustrations are constructed, much discussion is needed as to the principles to be taught, and as to the forms that are to be chosen for types. The Geographical Society still has a large work before it in this direction. W. M. DAVIS.

Cambridge, Mass., Aug. 28.

The Blair Educational Bill.

IN *Science* of Aug. 19 is a note on the Blair bill, by James Lawrey of Iowa. Mr. Lawrey declares that "any State that would accept national aid has not the spirit necessary to a sound government." Such a statement comes with very poor grace from one who resides in a State in which the schools are most richly endowed by the general government. Whence came the great educational funds of the western States, save from the munificent bounty of the general government? Has the spirit of the people of the State of Iowa, or of any western State, been, in any way, injured by the vast donations of land by the general government to these States? I understand that the great north-west was ceded to the nation for the benefit of all the people, by certain States having a good claim to the same. The later acquisitions by purchase and by conquest were all intended certainly for all the people. But in what way are the people of Pennsylvania or of Virginia benefitted by the school funds of Iowa or Nebraska, derived from the sale of lands belonging to all the people? These great land-grants are but little understood by the people of the East. A few years ago, when in Nebraska, I was told that the school lands of that State, if laid out in a belt two miles wide, would extend from the Atlantic to the Pacific Ocean.

I believe in the aims of the Blair Bill most fully, but I think it should be modified, in several particulars. 1. The money should be given to each State for the benefit of all school children in the same, but with no other restrictions. 2. The western States should receive no benefit from the grant until the old States have been granted sums to counterbalance the grants to the western States.

It is certainly a grave mistake on the part of our rulers to collect vast sums of money, more than are needed to conduct the government in an economical manner, but when once it is collected it should be returned in the most direct manner possible.

The South needs the aid. With ungallant restrictions removed, she will accept and make good use of it, I feel as sure as I do that it would do good in my own State. GEO. G. GROFF.

Bucknell University, Lewisburg, Penn.

Wind Pressure and Velocity.

REFERRING to Mr. H. Allen Hazen's letter in your issue of the 2d inst., I beg to call attention to the fact that the temperature of the wind enters as an important factor in the determination of the pressure due to a given velocity. In 1876 (*Engineering and Mining Journal*) I first pointed out that a variation in temperature from 0° F. to 100° F. produces a difference in the amount of pressure, for a given velocity of wind, of over one-fifth the total amount. I have since discussed the subject more fully in a little treatise on 'The Windmill as a Prime Mover' (New York, John Wiley & Sons, 1885), giving detailed formulæ and complete tables, showing the relation between the pressure and velocity of wind.

Further *accurate* experimental determinations are certainly necessary, but all data entering the problem (among them, the temperature of the impinging air) should be carefully noted, and given due weight in any generalization drawn from the experiments.

ALFRED R. WOLFF.

New York, Sept. 5.